Progress Report on the UCLA(Quad) Ring Cooler

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- Historically, a ring cooler with conventional magnets was proposed to stack-up mini-bunches transversely (emittance exchange, longitudinal ⇒ transverse) by using 2 rings at 1 GeV/c : (fig 1, fig 2)
  a) Large ring(300 m circumference) with Li lens b) small ring to stack-up mini-bunches
- Started with H_2 absorbers with tapered ends at 1 GeV/c.
  Ring designed by Al with SYNCH (Hard Edge magnetic field) Ray-traced with ICOOL

  quad - sector dipole - quad
  combined function sector dipole (Hard Edge mode was created)

  This model is the First Ring cooler model simulated by the ICOOL or GEANT to demonstrate the emittance Exchange and the 6 dimensional Cooling.

  Equilibrium
  ϵ_{nx}, ϵ_{ny}, 1 mm rad (input = 2 mm rad)
  $\epsilon_{nz} \sim$ 10 mm(Neuffer) (input = 20 mm)
- Diagnostics is always a BIG job in ICOOL simulation.
  β_x, β_y, Dispersion(η) calculation, combined with 4 σ tail cuts in the emittance calculation inside the ICOOL.
- Muons are lost due to resonances at Δp/p = +10 %, -5 %.
- Need a ring design for the Li lens cooler.

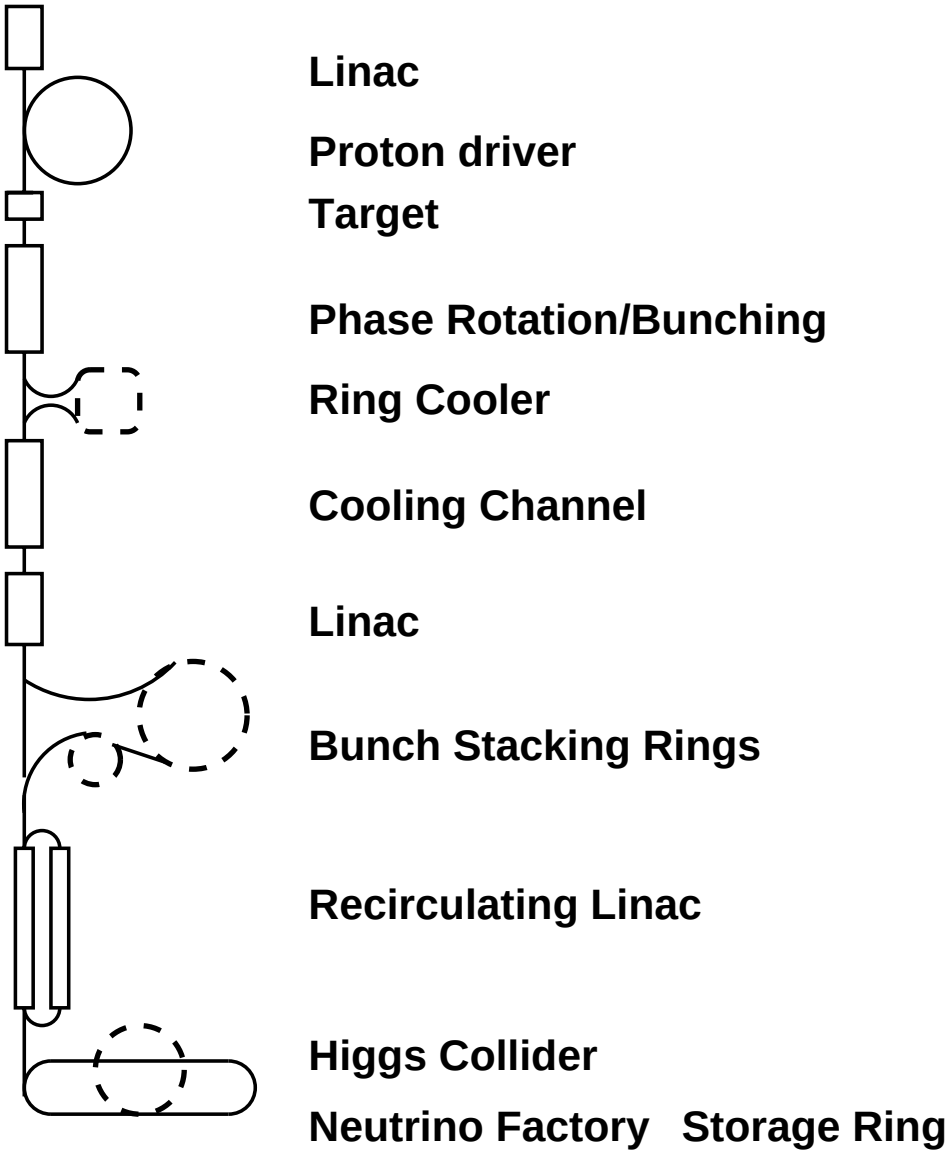


Figure 1: Schematic Diagram of the Higgs Factory and the Neutrino Factory

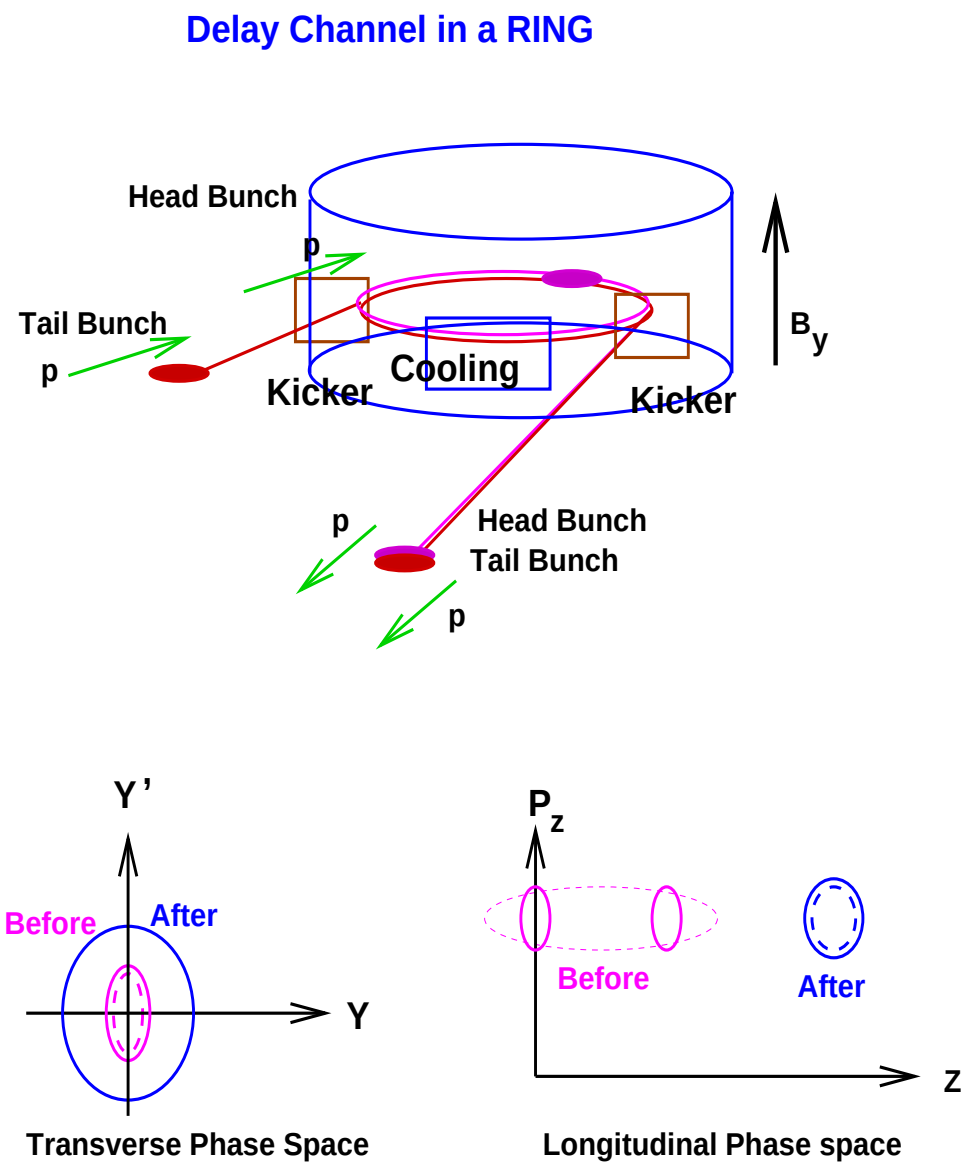
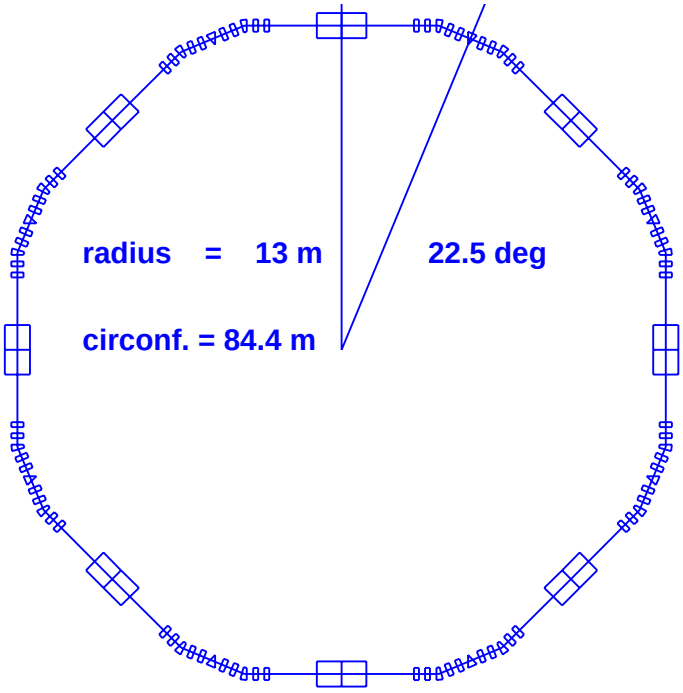


Figure 2: Schematic Diagram of the transverse bunch stacking in a bunch stacking ring



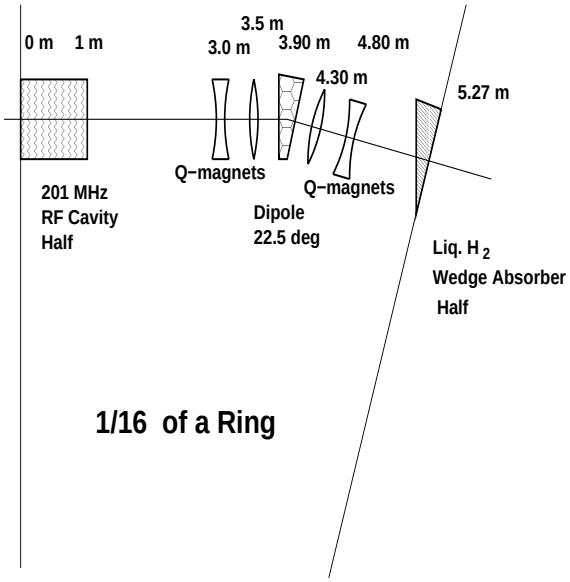


Figure 3: Top view of the "UCLA" Emittance Exchange Ring, and a schematic drawing of a ring components in the 22.5 degree section

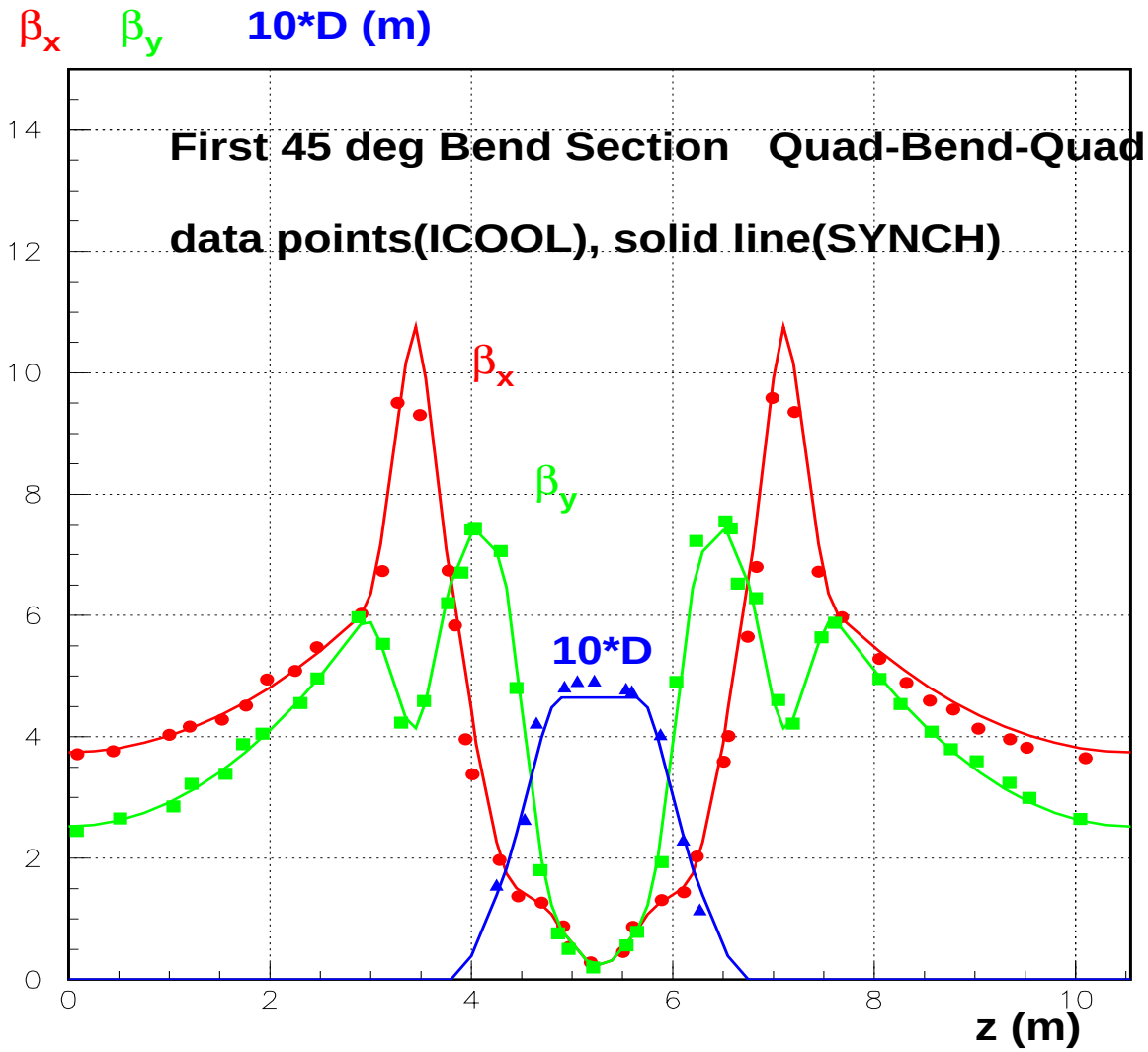


Figure 4: ICOOL - SYNCH comparison

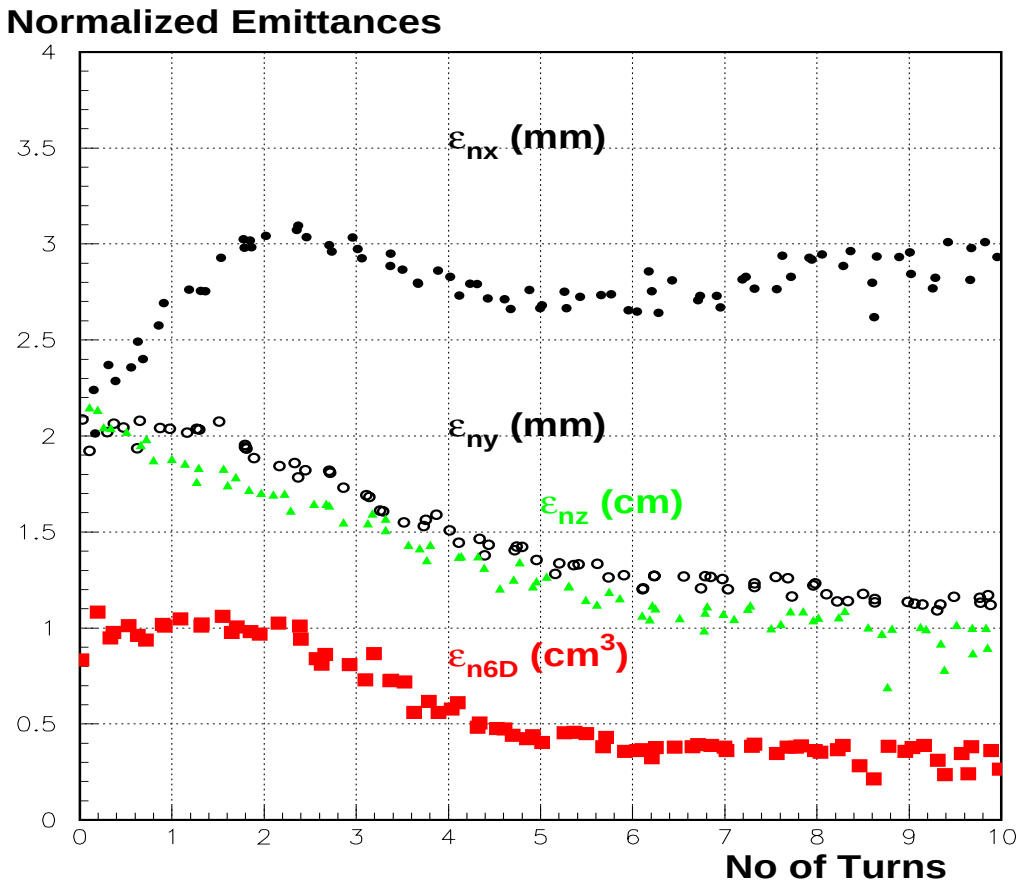


Figure 5: Normalized Emittances as a function of z

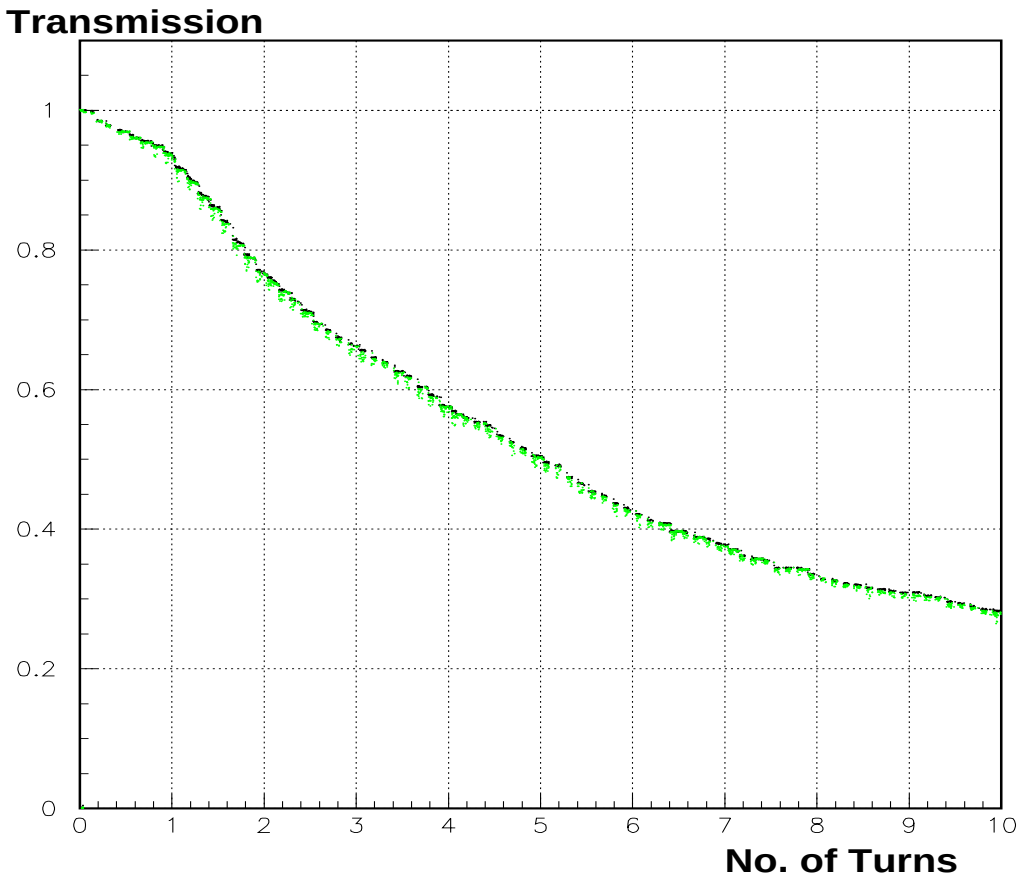


Figure 6: Transmission of muon as a function of number of turns

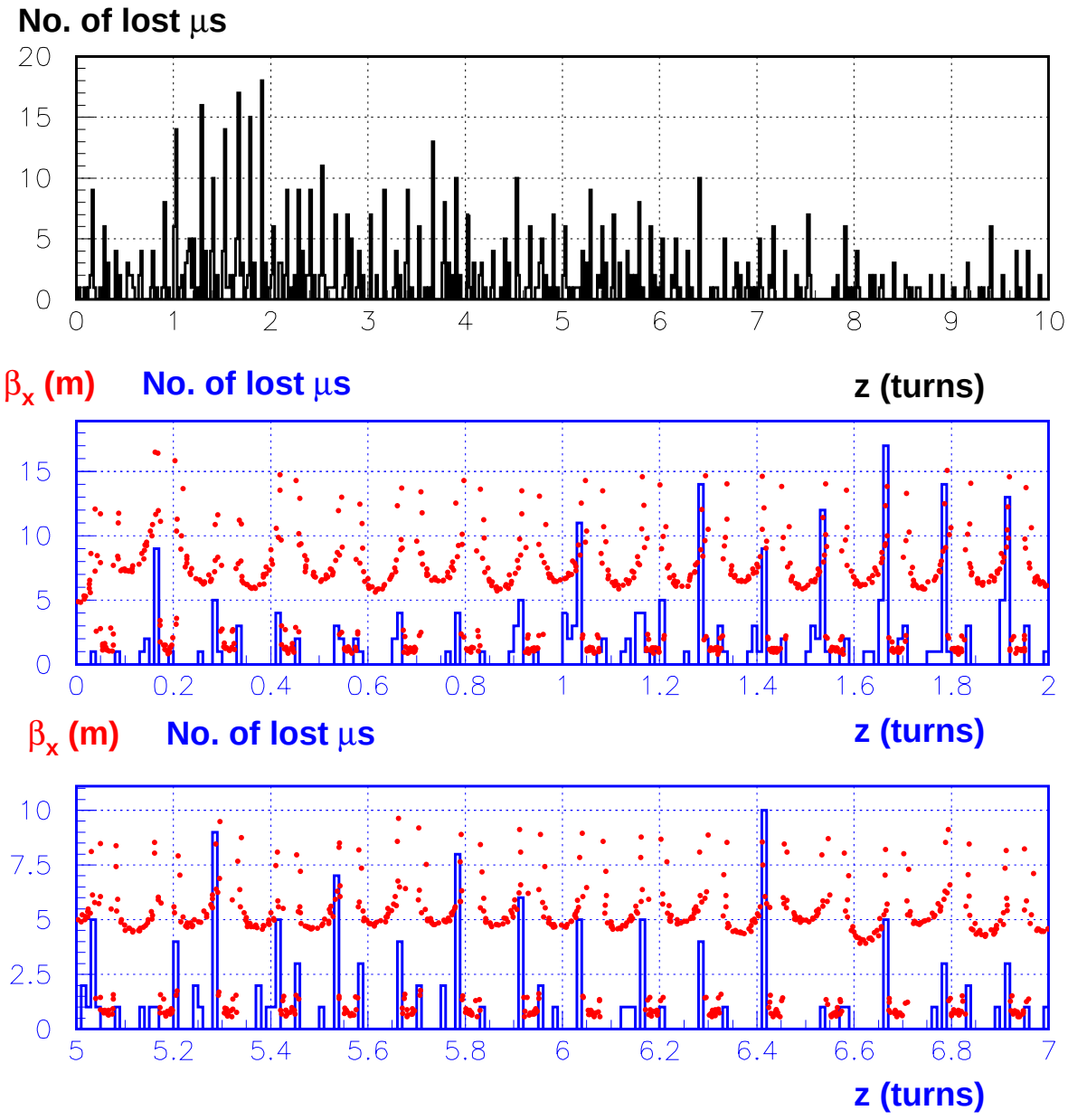


Figure 7: z location of the lost muons

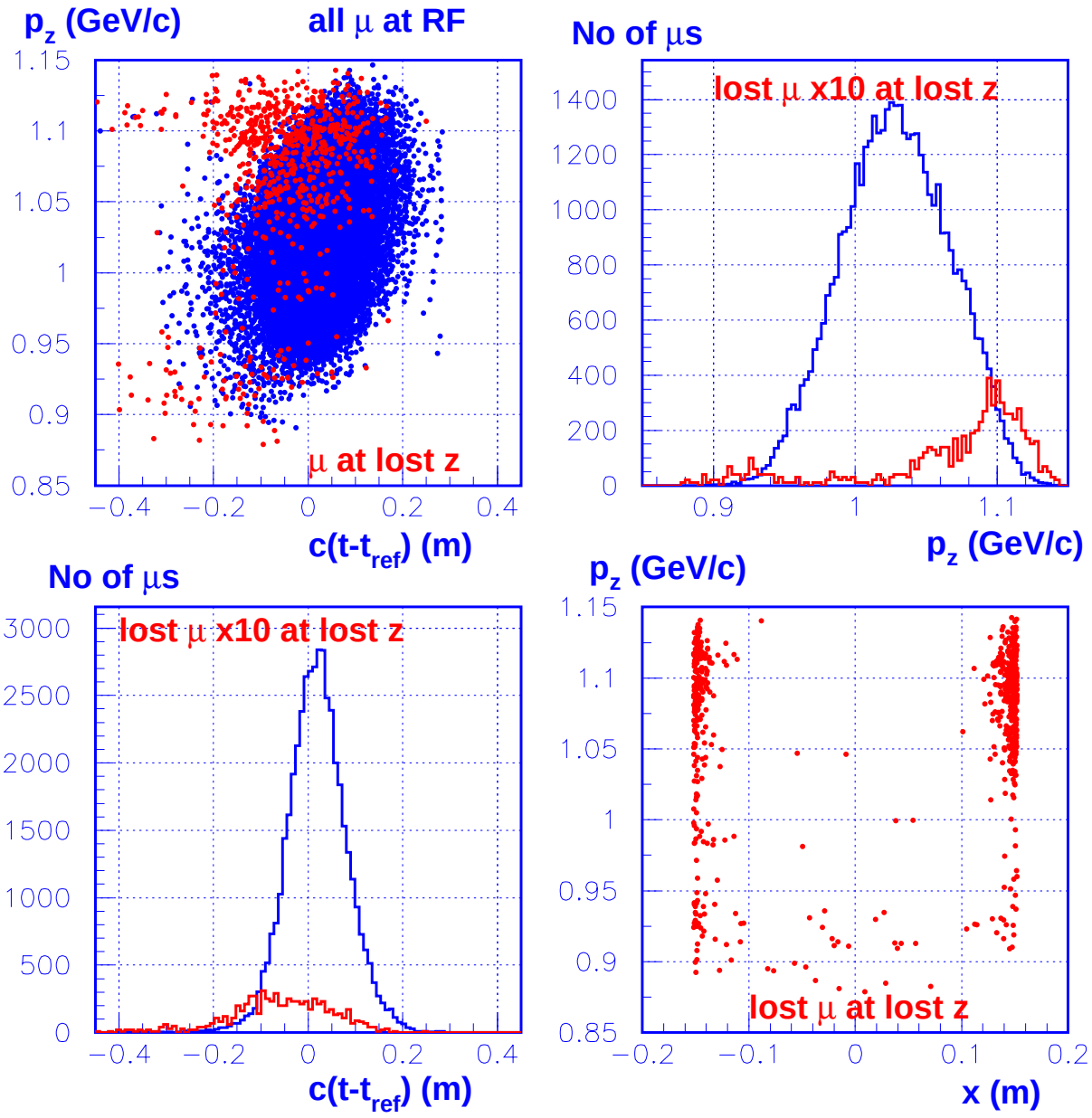


Figure 8: Longitudinal phase space of the lost muons, compared with transported muons

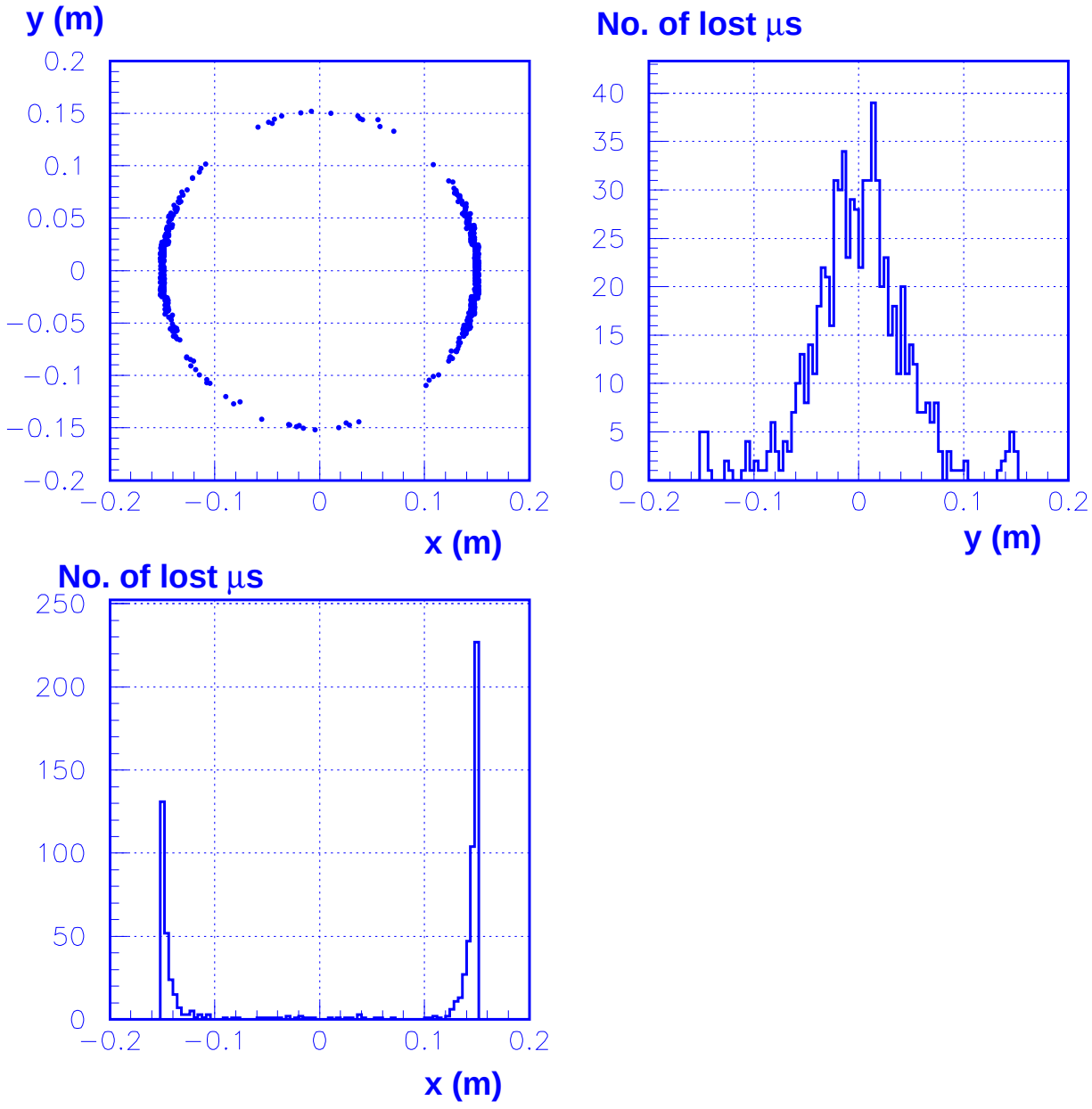


Figure 9: x, y location of the lost muons

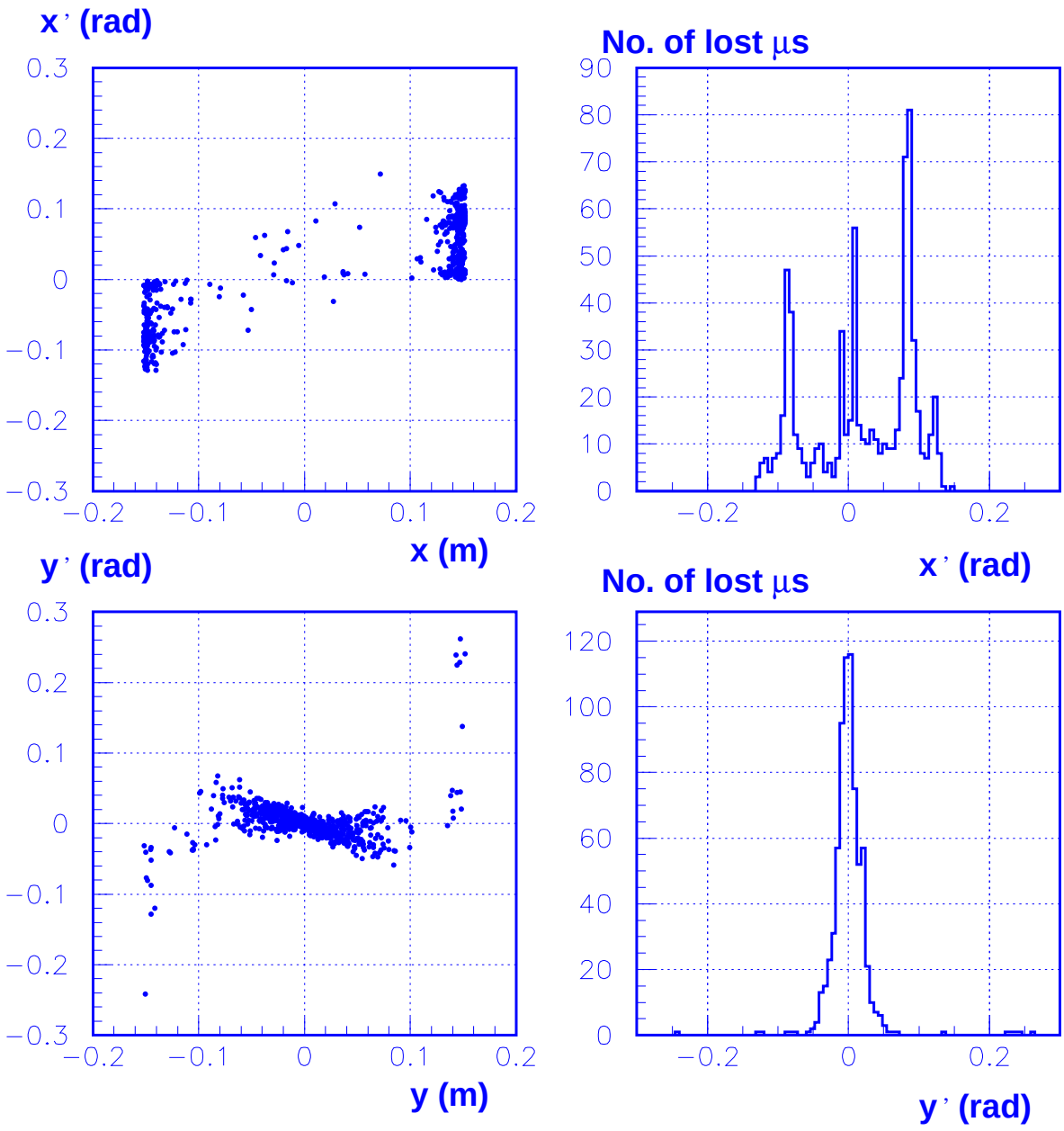
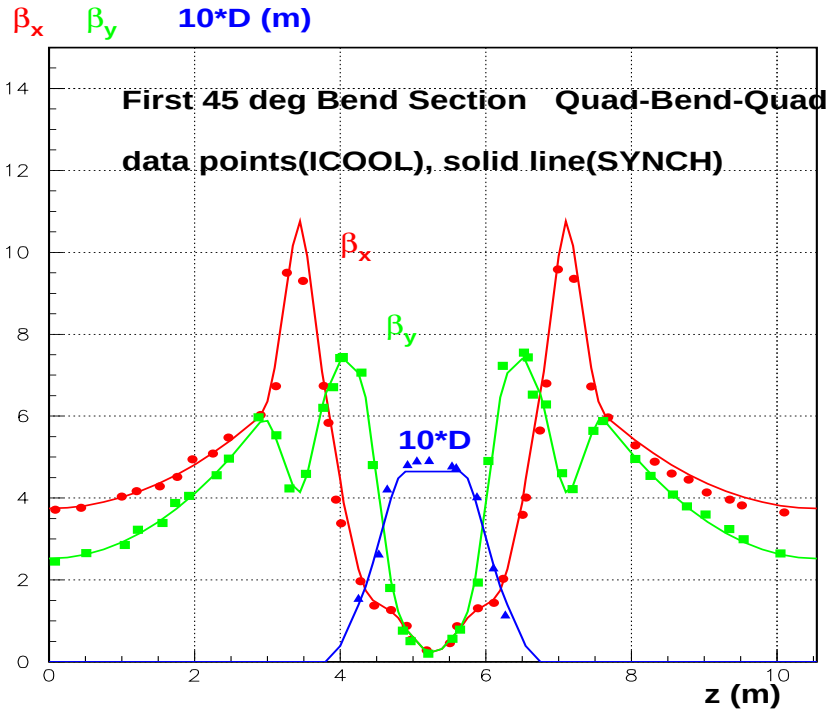


Figure 10: transverse phase space of the lost muons



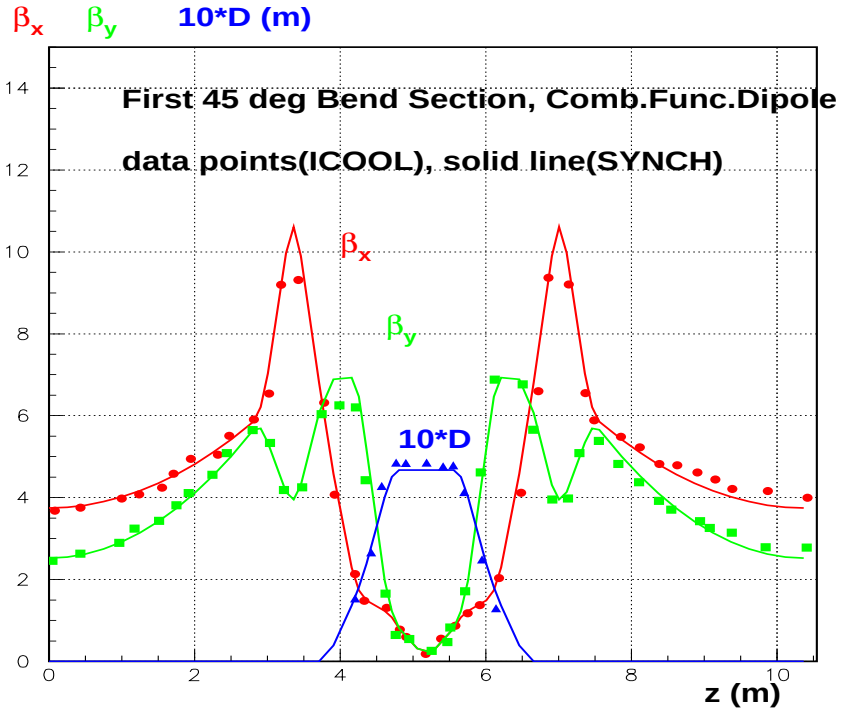


Figure 11: transverse phase space of the lost muons

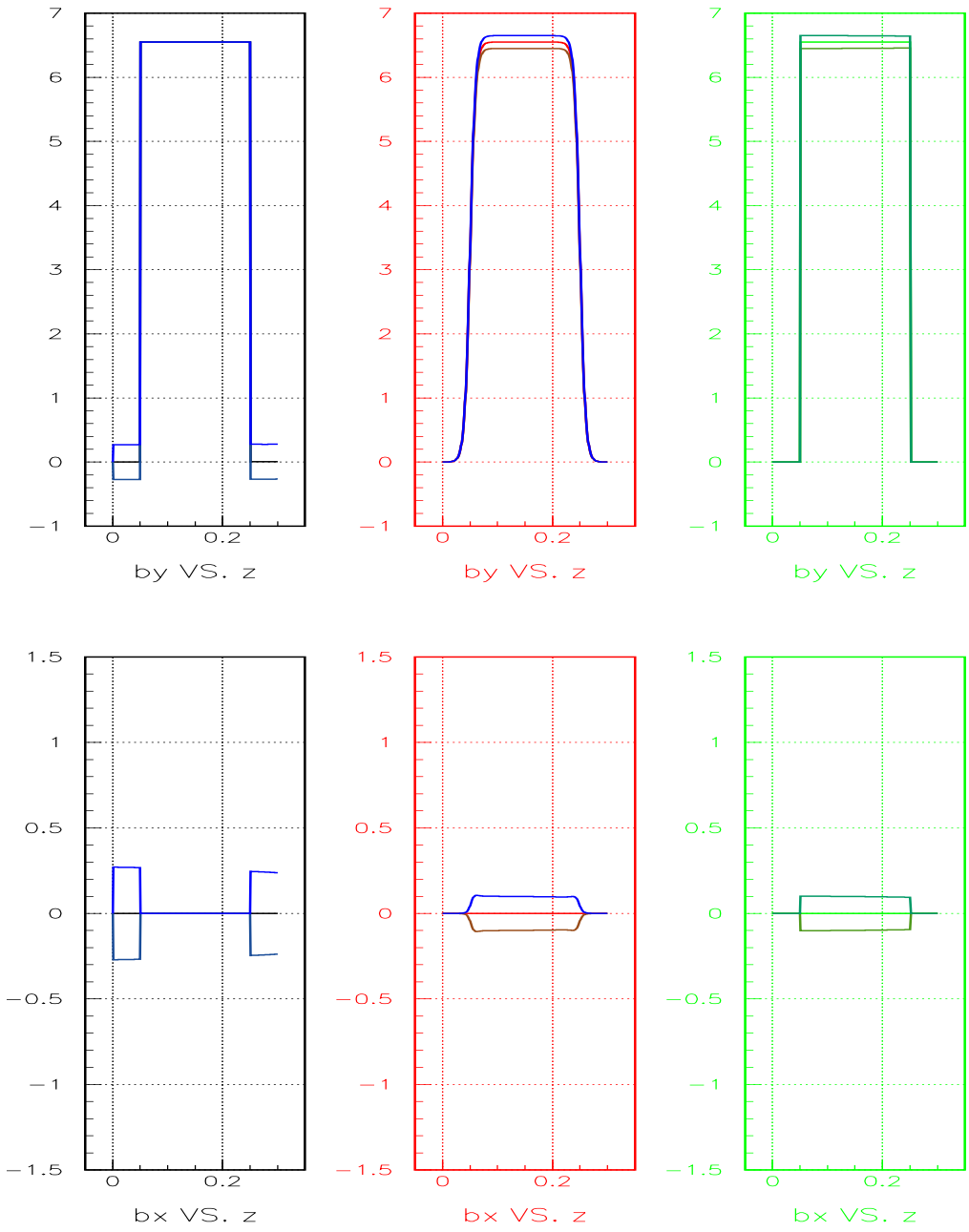


Figure 12: B_y andB_x in the hard edge quad-sector dipole-quad, soft and hard edge combined function sector dipole

Summary

- Emittance Exchange and 6D cooling was demonstrated with the conventional magnet ring by using ICOOL simulation.
- Work is in progress to implement sextupole magnets to get larger Δp/p range.
- Plan to use COSY or MAD, and ICOOL to simulate an emittance exchange / cooling ring with soft edge magnetic fields.
- Need more efficient model of the emittance exchange/6D cooling ring with Li lens.